Memorandum of Understanding
between
The Dark Energy Survey Collaboration
and the Survey of the Magellanic Stellar History Collaboration

I. Introduction

This Memorandum of Understanding describes the mutual agreement that the Dark Energy Survey (DES) and the Survey of the Magellanic Stellar History (SMASH) collaborations have reached in order to carry out joint science analyses using their data sets. The aim of this MOU is to foster and lay out the guidelines for such joint efforts, in order to enhance the science output of both projects. The duration of the MOU is two years from the date that it has been adopted by senior management of both collaborations, extendable for the duration of both projects. The collaborations may choose to extend the MOU or to alter its terms by amending it if both agree. They may also shorten the duration of it (including immediately terminating it) at the behest of the management of either collaboration. This MOU does not
preclude these collaborations from separately entering into agreements or understandings with other projects.

II. The Collaborations

The Survey of the Magellanic Stellar History is a community DECam project led by David Nidever (U. Michigan) and Knut Olsen (NOAO) that has been granted 40 nights of DECam (including 10 nights of Science Verification) and 28 nights of 0.9m for calibration, with the goal to cover ~2500 sq. deg at 20% filling factor covering the Magellanic Clouds and their extended structure down to around 24^{th} mag in ugriz. The full list of SMASH members, as of March 2015, is provided in the end of this section.

The Dark Energy Survey collaboration comprises scientists from Fermilab, University of Illinois at Urbana-Champaign, the University of Chicago, Lawrence Berkeley National Laboratory, the National Optical Astronomy Observatory, the National Center for Supercomputer Applications, the Spain DES consortium (Instituto de Ciencias del Espacio, Institut de Fisica d'Altes Energies, and Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas), the United Kingdom DES consortium (University College London, the University of Portsmouth, the University of Cambridge, the University of Edinburgh, the University of Sussex, the University of Nottingham), the University of Michigan, the DES Brazil consortium (Observatorio Nacional, Laboratório | Nacional de Computação Científica, Universidade Federal do Rio Grande do Sul), the University of Pennsylvania, Argonne National Laboratory, the Ohio State University, the South Bay Consortium (University of California at Santa Cruz, SLAC National Laboratory, Stanford University), Texas A&M University, and USM. The DES collaboration is managed by the DES Management Committee; the Chair of the Management Committee is Josh Frieman, the Project Director, who reports to the DES Council and the DOE-NSF Joint Oversight Group. The scientific work of the collaboration is managed by the DES Science Committee, which comprises the coordinators of the

Science Working Groups and a chair or co-chairs. DES policy documents relevant to this MOU include the DES Membership Policy, the DES Publication Policy, and the Science Committee Charter.

The DES collaboration has constructed a new wide-field optical imaging instrument for the Blanco 4-meter telescope at Cerro Tololo InterAmerican Observatory (CTIO) in Chile, developed an associated data management system, wrote science analysis pipelines, and upgraded the telescope facility.

The primary scientific aim of the DES is to probe dark energy through galaxy clusters, weak lensing, large-scale structure, and supernovae, but it has also brought together leading scientists in the fields of stellar populations and Galactic structure. Dark Energy Survey operations at CTIO began in 2013 and will cover 525 nights, ending in 2018. The bulk of the DES observing time will be devoted to a multi-band survey covering approximately five thousand square degrees.

SMASH Team Members

David Nidever (P.I., U. Michigan)
Knut Olsen (co P.I., NOAO)
Eric Bell (U. Michigan)
Gurtina Besla (U. Arizona)
Robert Blum (NOAO)
Thomas de Boer (U. Cambridge)
You-Hua Chu (U. Illinois)
Maria-Rosa Cioni (U. Hertfordshire)
Blair Conn (Gemini Obs.)
Carmé Gallart (IAC)
Robert Gruendl (U. Illinois/NCSA)
Shoko Jin (U. Groningen)
Cliff Johnson (U. Washington/UCSD)
Catharine Kaleida (NOAO)
Hwihyun Kim (ASU)
Andrea Kunder (Leibnitz Inst., Potsdam)
Steven Majewski (U. Virginia)
Nicolas Martin (MPIA Heidelberg)
David Martinez-Delgado (U. Heidelberg)
Antonela Monachesi (U. Michigan)
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Ricardo Muñoz (U. Chile)
Noelia Noel (U. Surrey)
Edward Olszewski (U. Arizona)
Abi Saha (NOAO)
Guy Stringfellow (U. Colorado)
Roland van der Marel (STScI)
Kathy Vivas (NOAO)
Alistair Walker (NOAO)
Dennis Zaritsky (U. Arizona)

III. Rational

SMASH was designed to be as complementary to DES as possible in terms of the Magellanic system area coverage. A combined SMASH+DES dataset would thus make a powerful combination for mapping the full extent of Magellanic Cloud stellar populations. It would also be powerful for tracing the profiles of the Galactic halo and thick disk, and for discovering previously unknown halo substructure and faint dwarf galaxy companions. While the SMASH survey area of 480 sq. deg. represents only a ∼10% increase in the DES survey area, it probes a ∼2400 sq. deg. area of sky at ∼20% fill factor, including areas on the north side of the Galactic plane and in the vicinity of the south celestial pole. Finally, the additional area of sky that SMASH would also contribute to DES, and the addition of the u filter would be valuable for both stellar and extragalactic science, since it will allow, as examples, better photo-z estimates and more efficient searches for AGNs at low and intermediate redshifts.

Potential projects along the lines stated above include:

1. Comparison of SMASH catalogs with DES Catalogs. In order to facilitate projects such as those listed below, an initial enabling project would be to compare catalogs from the two projects. It is already known that there are differences between the SMASH/Daophot and the DES/Sextractor outputs. An extension of this task would be to process some SMASH data with the DES pipeline through the photometric calibration stage to compare the resulting stellar samples.
2. Search for the stellar component of the Magellanic Stream (which is covered by DES) and the Leading Arm (which is covered by SMASH). The detection of stellar debris in these structures would make them the only tidal streams with known gaseous and stellar components.
3. Detect and map the smooth components of the Clouds, including their extended disks and potential stellar halos, which for full azimuthal coverage requires both the SMASH and DES datasets. The size and shape of the LMC's stellar disk is a direct probe of the tidal radius of the LMC, with which we can explore the dark matter halos of the LMC and Milky Way.
4. Detect and map potential streams and substructure (including satellites) in the Magellanic periphery not associated with H I features. These would probe stages in the formation and interaction of the Clouds at times earlier than the H I dissipation timescale.
5. Derive spatially resolved, precise star formation histories covering all ages of the MCs and to large radii, thus providing detailed information on their complete evolution. These can be broken down into subprojects by location with respect to the Clouds, e.g. the main bodies, the Bridge region, and their southern extent (SMASH), and the northern extent (DES).
6. Tracing the profiles of the smooth Milky Way halo and thick disk components over a large range of Galactic latitude and longitude.
7. Searching for Milky Way substructure as a function of distance from the Milky Way plane, with SMASH providing data closer to the plane and DES data farther from it.
8. Identifying unknown faint Milky Way dwarf galaxy companions.
9. Identifying candidate very metal-poor stars for follow up with spectroscopy.
10. Cosmic variance in background galaxy counts over large angular scale.
11. Identification of candidate quasars with u band.

These synergies and complementarities are the primary motivation for carrying out joint analyses of the SMASH and DES data sets, but they do not exhaust the possibilities.

IV. Principles of Agreement

The two collaborations agree on the following principles that will guide their joint efforts:

1. At the convenience and interest of both parties, the collaborations will pursue joint

analyses of SMASH and DES data where their science topics and goals overlap. These analyses will be pursued collaboratively and will be open to all members of the DES and SMASH collaborations. For DES, this includes members, associate members, and approved participants (students and postdocs), as defined by the DES Membership Policy.

2. Joint analyses are those that are based upon both SMASH and DES data. Science analyses that involve only SMASH or only DES data are not subject to this MOU.
3. When a joint analysis project is being planned, each collaboration will identify one or two collaboration members who will act as primary liaisons for that project with the liaisons of the other collaboration. The liaisons and those initiating the joint project (who may be the same) will draft a joint project announcement, laying out the goals of the project, listing those initially involved or interested in the project, inviting others to participate, outlining expected publications and results, specifying which data from each collaboration will be included, and giving expected timeline to completion. These announcements shall be circulated electronically to the members of both collaborations. On the DES side, the announcements will be made in the form of External Collaborator proposals, and should be vetted by the relevant Working Group coordinators, the Science Committee and the Management Committee, and will be made part of the DES project announcement archive. The list of joint analysis project members should be updated as it evolves and should be communicated to both collaborations. On the SMASH sides, joint projects will be vetted by SMASH leadership (Nidever/Olsen), approved by the SMASH collaboration, and included in the "Science Projects" SMASH wiki page.
4. On the DES side, joint analyses with SMASH will be coordinated by the relevant Working Groups and overseen by the Science Committee, with regular reports/updates to the DES Management Committee. The Science Committee and/or the Management Committee may request revisions or clarifications in the joint project announcements, and Management Committee approval of the scope and list of participants (including all students and postdocs) will be required for the project to proceed.
5. To facilitate these efforts, the liaisons should strive to maintain open communication between the joint analysis project members in the respective collaborations, through regular meetings, email communication, technical notes, etc. On the DES side, this could include inviting analysis project members from SMASH to participate in relevant DES Working Group meetings. Regular updates on all joint analysis projects and preliminary results shall be provided to the relevant DES Working Groups.
6. DES data access may be granted to joint analysis project members from the SMASH collaboration. That access will be solely for the purpose of carrying out the approved joint analysis project. In this respect, SMASH members in the joint analysis project will have the rights and responsibilities of External Collaborators, as defined by the DES Membership Policy. The SMASH collaboration may reciprocally provide access to non-public SMASH data to members of the DES collaboration involved in the joint analysis, with identical conditions and restrictions to those above. Those granted access to data from a collaboration of which they are not members agree to abide by all collaboration rules regarding such data and in particular agree not to disseminate such data outside the joint analysis team or outside the collaborations. They also agree to use such data only for the joint analysis.
7. The communication and publication of joint SMASH-DES results are subject to the publication policies and guidelines of both collaborations. On the DES side, this implies that joint publications are subject to the DES publication procedures, including internal review by an editorial review committee prior to release of results or publications, as well as to DES authorship inclusion and authorship ordering rules. Resulting joint publications will also be subject to the publication guidelines of the SMASH collaboration. In cases where those policies may not be in agreement, the lead authors will work with the scientific and management leadership of the two projects to arrive at a mutually agreed resolution. Those participating in joint analysis projects agree to read and abide by any publication policies of

the other collaboration.

8. According to the DES Publication Policy, certain categories of talks and presentations of DES results are managed by the DES Speakers' Bureau. When it comes to presentations of joint SMASH-DES results, the DES Speakers' Bureau will coordinate with SMASH management to ensure fairness and balance in representation between the collaborations.
9. In order to facilitate joint analyses of the two data sets, reduction and calibration of SMASH observations by DESDM, and/or reduction of some DES observations by the Community Pipeline, would be highly desirable. The issue of data homogeneity should be addressed as part of any proposed joint project.
10. Any disputes between joint analysis project members shall be brought to the science and senior management of both collaborations for resolution. Any issues arising from potential conflicts between the policies of the two collaborations shall also be brought to the science and senior management of the collaborations for resolution.

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